3_protocol_controlled_value

August 8, 2022

1 Experiment Notebook: Protocol-Controlled Value Analyses

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3 Experiment Summary

The purpose of this notebook is to illustrate and evaluate the effect of a target Stable Backing Ratio and Contractionary Monetary Policy applied to Liquidity Pool protocol-owned liquidity and Money Market protocol-supplied FEI on key system dynamics and KPIs.

4 Experiment Assumptions

See assumptions document for further details.

5 Experiment Setup

We begin with several experiment-notebook-level preparatory setup operations:

- Import relevant dependencies
- Import relevant experiment templates
- Create copies of experiments
- Configure and customize experiments

Analysis-specific setup operations are handled in their respective notebook sections.

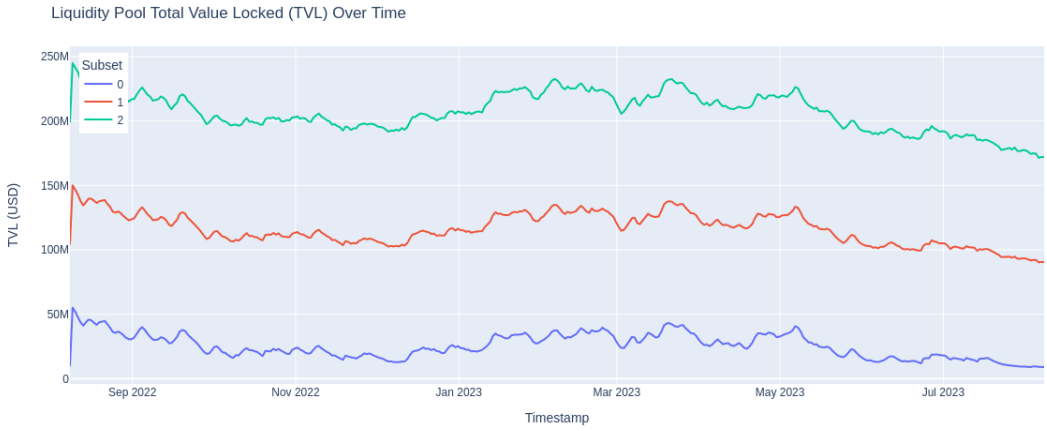
6 Analysis 1: FEI Volatile Liquidity Pool Leverage

This analysis serves to answer the what-if question: What leverage effect does protocol-owned liquidity have on user-circulating FEI and collateralization of the protocol in different market trends?

```
array([1.00e+07, 1.05e+08, 2.00e+08])
```

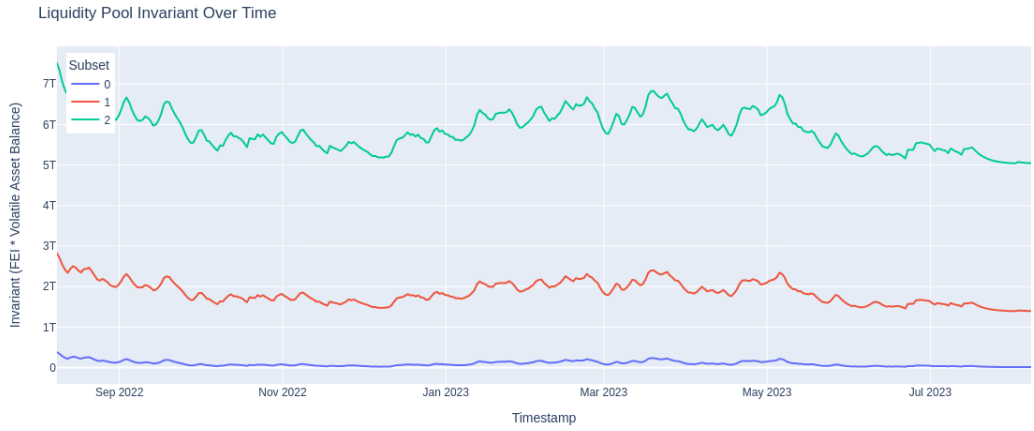
```
2022-08-08 16:07:06,690 - root - INFO - Running experiment
2022-08-08 16:07:06,800 - root - INFO - Setting up initial state
2022-08-08 16:07:06,806 - root - INFO - Setting up initial state
2022-08-08 16:07:06,812 - root - INFO - Setting up initial state
2022-08-08 16:07:06,878 - root - INFO - Starting simulation 0 / run 0 / subset 0
2022-08-08 16:07:06,921 - root - INFO - Starting simulation 0 / run 0 / subset 1
2022-08-08 16:07:06,979 - root - INFO - Starting simulation 0 / run 0 / subset 2
2022-08-08 16:07:11,500 - root - INFO - Experiment complete in 4.804606914520264
seconds
2022-08-08 16:07:11,502 - root - INFO - Post-processing results
2022-08-08 16:07:14,022 - root - INFO - Post-processing complete in
2.5215883255004883 seconds
```

The liquidity pool TVL initial state was swept over three values:

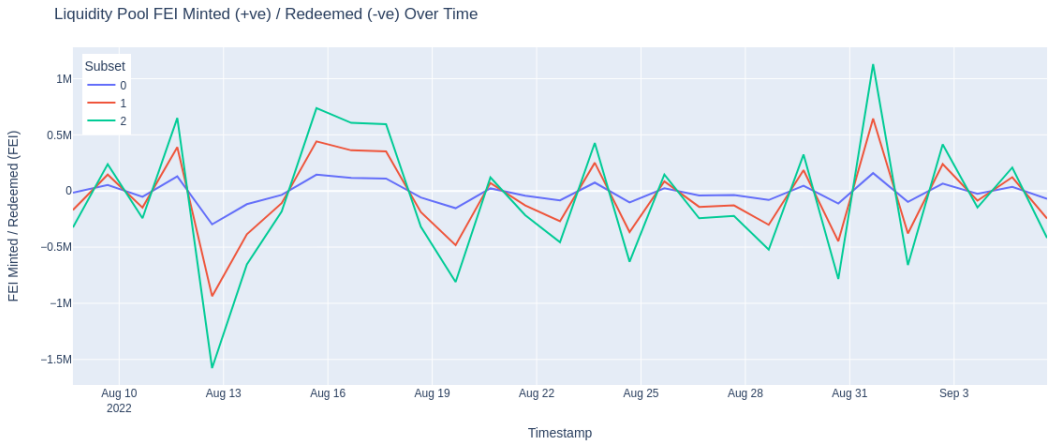


A single stochastic Volatile Asset price realisation was used with a negative trend to simulate a bearish market:

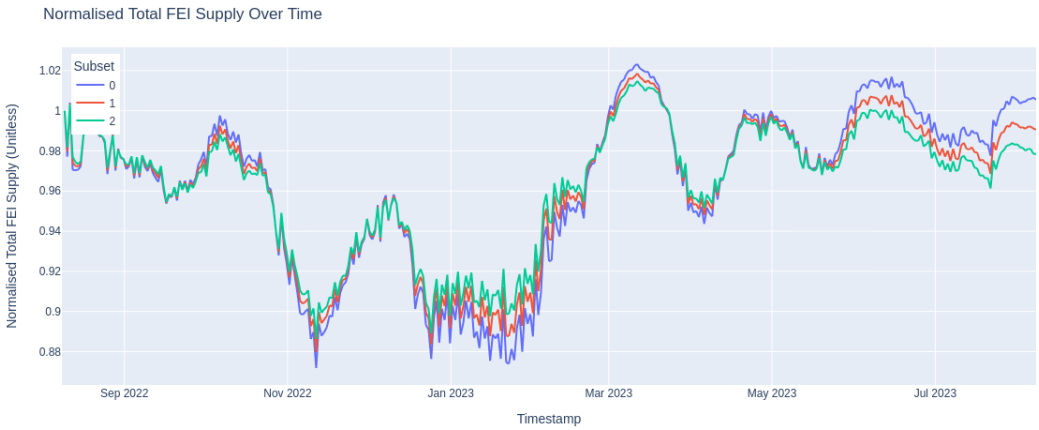
The change in volatility with increased liquidity is more pronounced when looking at the constant product invariant, and the invariant drives a number of the metrics that follow. The change in volatility of the invariant is specifically caused by the movement of liquidity in and out of the pool by user FEI capital allocation.



For a specific change in volatile asset price - the larger the invariant, the larger the pool imbalance and resulting minting and redemption required to rebalance the pool:



The volatility in total FEI supply due to arbitrage minting and redemption is more pronounced for deeper liquidity pools:

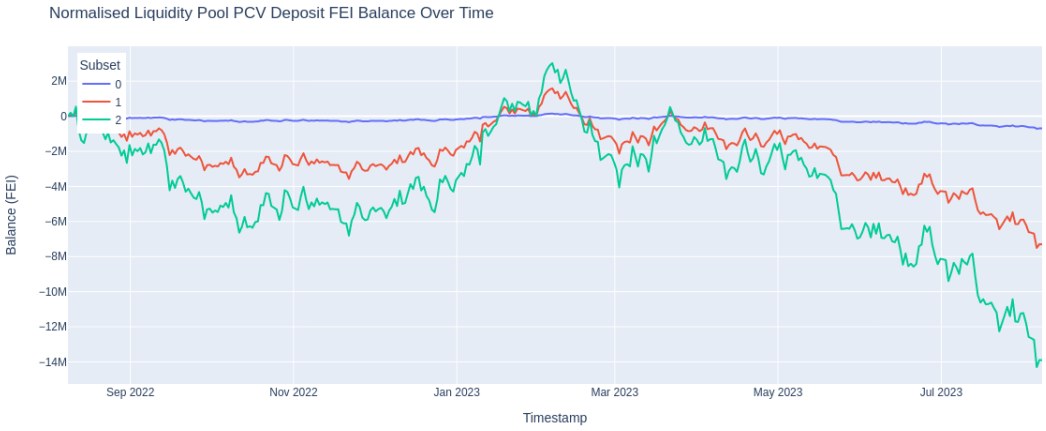


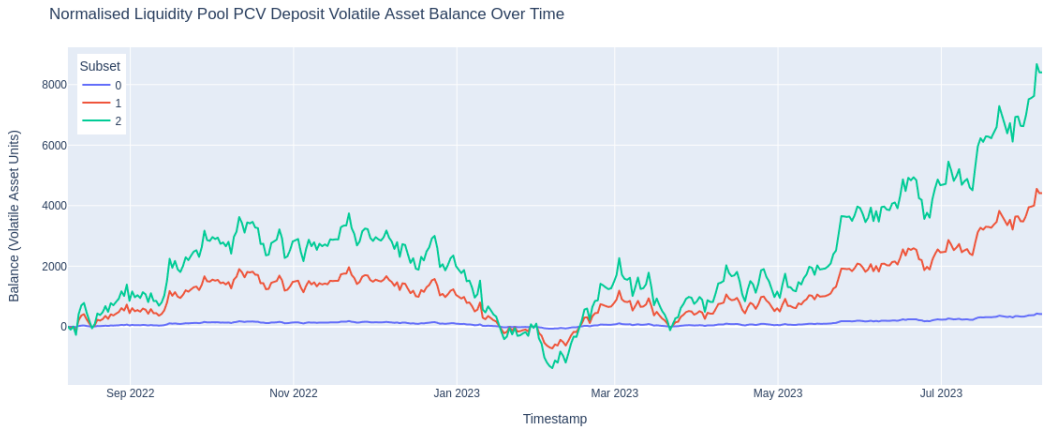
As expected, the FEI and Volatile Asset liquidity pool balances move in opposite directions and with greater covariance the larger the constant product invariant:

```
fei_liquidity_pool_pcv_deposit_balance  \
subset
0      fei_liquidity_pool_pcv_deposit_balance
2.748351e+10
       volatile_liquidity_pool_pcv_deposit_balance
-1.568250e+07
1      fei_liquidity_pool_pcv_deposit_balance
3.030057e+12
       volatile_liquidity_pool_pcv_deposit_balance
-1.728995e+09
2      fei_liquidity_pool_pcv_deposit_balance
1.099341e+13
```

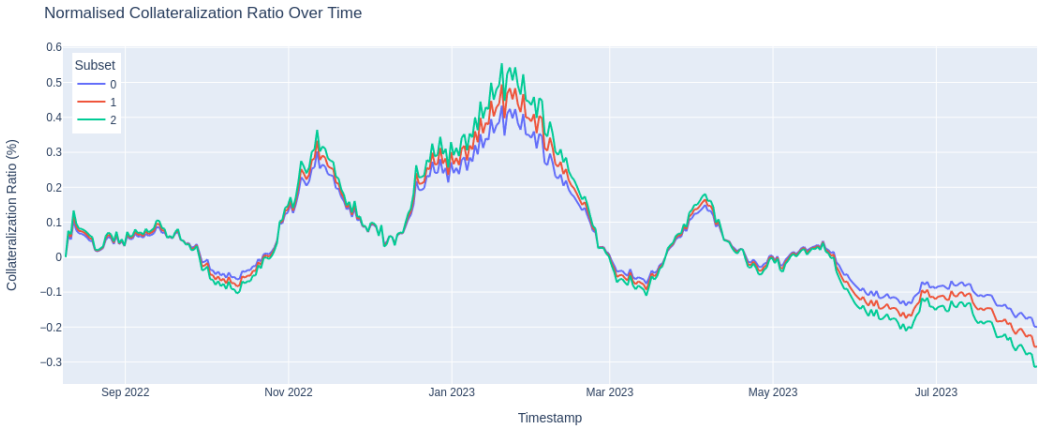
```
       volatile_liquidity_pool_pcv_deposit_balance
-6.272999e+09

volatile_liquidity_pool_pcv_deposit_balance
subset
0      fei_liquidity_pool_pcv_deposit_balance
-1.568250e+07
       volatile_liquidity_pool_pcv_deposit_balance
8.991511e+03
1      fei_liquidity_pool_pcv_deposit_balance
-1.728995e+09
       volatile_liquidity_pool_pcv_deposit_balance
9.913141e+05
2      fei_liquidity_pool_pcv_deposit_balance
-6.272999e+09
       volatile_liquidity_pool_pcv_deposit_balance
3.596604e+06
```





Due to higher impermanent loss and leverage of deeper liquidity pools, the collateralization ratio of the protocol is negatively impacted in a market downturn:



7 Analysis 2: PCV at Risk for Stable Backing Ratio Targets

The analysis serves to answer the what-if question: What effect does a PCV management strategy targetting a Stable Backing Ratio have on PCV at Risk and collateralization of the protocol? We'll statistically evaluate the efficacy of different policy settings.

7.0.1 Parameters Sweeped:

We sweep the target stable backing ratio and rebalance direction in the following way: - Policy 1 (bullish) - keep stable backing ratio below 0.3 - Policy 2 (conservative) - keep stable backing ratio above 0.8

Both policies are executed quarterly over the simulation. The simulation has 100 monte carlo runs.

```
2022-08-08 16:07:25,167 - root - INFO - Running experiment
2022-08-08 16:07:25,250 - root - INFO - Setting up initial state
2022-08-08 16:07:25,257 - root - INFO - Setting up initial state
2022-08-08 16:07:25,263 - root - INFO - Setting up initial state
2022-08-08 16:07:25,268 - root - INFO - Setting up initial state
2022-08-08 16:07:25,273 - root - INFO - Setting up initial state
2022-08-08 16:07:25,278 - root - INFO - Setting up initial state
2022-08-08 16:07:25,284 - root - INFO - Setting up initial state
2022-08-08 16:07:25,289 - root - INFO - Setting up initial state
2022-08-08 16:07:25,300 - root - INFO - Setting up initial state
2022-08-08 16:07:25,305 - root - INFO - Setting up initial state
2022-08-08 16:07:25,312 - root - INFO - Setting up initial state
2022-08-08 16:07:25,317 - root - INFO - Setting up initial state
```

```
2022-08-08 16:07:25,322 - root - INFO - Setting up initial state
2022-08-08 16:07:25,327 - root - INFO - Setting up initial state
2022-08-08 16:07:25,332 - root - INFO - Setting up initial state
2022-08-08 16:07:25,337 - root - INFO - Setting up initial state
2022-08-08 16:07:25,341 - root - INFO - Setting up initial state
2022-08-08 16:07:25,348 - root - INFO - Setting up initial state
2022-08-08 16:07:25,352 - root - INFO - Setting up initial state
2022-08-08 16:07:25,358 - root - INFO - Setting up initial state
2022-08-08 16:07:25,363 - root - INFO - Setting up initial state
2022-08-08 16:07:25,368 - root - INFO - Setting up initial state
2022-08-08 16:07:25,373 - root - INFO - Setting up initial state
2022-08-08 16:07:25,377 - root - INFO - Setting up initial state
2022-08-08 16:07:25,382 - root - INFO - Setting up initial state
2022-08-08 16:07:25,387 - root - INFO - Setting up initial state
2022-08-08 16:07:25,391 - root - INFO - Setting up initial state
2022-08-08 16:07:25,397 - root - INFO - Setting up initial state
2022-08-08 16:07:25,402 - root - INFO - Setting up initial state
2022-08-08 16:07:25,406 - root - INFO - Setting up initial state
2022-08-08 16:07:25,412 - root - INFO - Setting up initial state
2022-08-08 16:07:25,416 - root - INFO - Setting up initial state
2022-08-08 16:07:25,422 - root - INFO - Setting up initial state
2022-08-08 16:07:25,427 - root - INFO - Setting up initial state
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2022-08-08 16:07:25,437 - root - INFO - Setting up initial state
2022-08-08 16:07:25,442 - root - INFO - Setting up initial state
2022-08-08 16:07:25,447 - root - INFO - Setting up initial state
2022-08-08 16:07:25,452 - root - INFO - Setting up initial state
2022-08-08 16:07:25,456 - root - INFO - Setting up initial state
2022-08-08 16:07:25,465 - root - INFO - Setting up initial state
2022-08-08 16:07:25,470 - root - INFO - Setting up initial state
2022-08-08 16:07:25,476 - root - INFO - Setting up initial state
2022-08-08 16:07:25,481 - root - INFO - Setting up initial state
2022-08-08 16:07:25,486 - root - INFO - Setting up initial state
2022-08-08 16:07:25,491 - root - INFO - Setting up initial state
2022-08-08 16:07:25,496 - root - INFO - Setting up initial state
2022-08-08 16:07:25,501 - root - INFO - Setting up initial state
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2022-08-08 16:07:25,511 - root - INFO - Setting up initial state
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2022-08-08 16:07:25,521 - root - INFO - Setting up initial state
2022-08-08 16:07:25,526 - root - INFO - Setting up initial state
2022-08-08 16:07:25,532 - root - INFO - Setting up initial state
2022-08-08 16:07:25,538 - root - INFO - Setting up initial state
2022-08-08 16:07:25,543 - root - INFO - Setting up initial state
2022-08-08 16:07:25,548 - root - INFO - Setting up initial state
2022-08-08 16:07:25,553 - root - INFO - Setting up initial state
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2022-08-08 16:07:25,564 - root - INFO - Setting up initial state
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2022-08-08 16:07:25,573 - root - INFO - Setting up initial state
2022-08-08 16:07:25,578 - root - INFO - Setting up initial state
2022-08-08 16:07:25,582 - root - INFO - Setting up initial state
2022-08-08 16:07:25,587 - root - INFO - Setting up initial state
2022-08-08 16:07:25,593 - root - INFO - Setting up initial state
2022-08-08 16:07:25,598 - root - INFO - Setting up initial state
2022-08-08 16:07:25,603 - root - INFO - Setting up initial state
2022-08-08 16:07:25,608 - root - INFO - Setting up initial state
2022-08-08 16:07:25,614 - root - INFO - Setting up initial state
2022-08-08 16:07:25,619 - root - INFO - Setting up initial state
2022-08-08 16:07:25,627 - root - INFO - Setting up initial state
2022-08-08 16:07:25,632 - root - INFO - Setting up initial state
2022-08-08 16:07:25,637 - root - INFO - Setting up initial state
2022-08-08 16:07:25,642 - root - INFO - Setting up initial state
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2022-08-08 16:07:25,656 - root - INFO - Setting up initial state
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2022-08-08 16:07:25,707 - root - INFO - Setting up initial state
2022-08-08 16:07:25,712 - root - INFO - Setting up initial state
2022-08-08 16:07:25,715 - root - INFO - Setting up initial state
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2022-08-08 16:07:25,731 - root - INFO - Setting up initial state
2022-08-08 16:07:25,736 - root - INFO - Setting up initial state
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2022-08-08 16:07:25,747 - root - INFO - Setting up initial state
2022-08-08 16:07:25,752 - root - INFO - Setting up initial state
2022-08-08 16:07:25,757 - root - INFO - Setting up initial state
2022-08-08 16:07:25,761 - root - INFO - Setting up initial state
2022-08-08 16:07:25,766 - root - INFO - Setting up initial state
2022-08-08 16:07:25,772 - root - INFO - Setting up initial state
2022-08-08 16:07:25,777 - root - INFO - Setting up initial state
2022-08-08 16:07:25,782 - root - INFO - Setting up initial state
2022-08-08 16:07:25,787 - root - INFO - Setting up initial state
2022-08-08 16:07:25,792 - root - INFO - Setting up initial state
2022-08-08 16:07:25,797 - root - INFO - Setting up initial state
2022-08-08 16:07:25,808 - root - INFO - Setting up initial state
```

```
2022-08-08 16:07:25,813 - root - INFO - Setting up initial state
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2022-08-08 16:07:25,823 - root - INFO - Setting up initial state
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2022-08-08 16:07:25,837 - root - INFO - Setting up initial state
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2022-08-08 16:07:25,956 - root - INFO - Setting up initial state
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2022-08-08 16:07:25,967 - root - INFO - Setting up initial state
2022-08-08 16:07:25,971 - root - INFO - Setting up initial state
2022-08-08 16:07:25,981 - root - INFO - Setting up initial state
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2022-08-08 16:07:25,991 - root - INFO - Setting up initial state
```

```
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2022-08-08 16:07:26,001 - root - INFO - Setting up initial state
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2022-08-08 16:07:26,016 - root - INFO - Setting up initial state
2022-08-08 16:07:26,021 - root - INFO - Setting up initial state
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2022-08-08 16:07:26,064 - root - INFO - Setting up initial state
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2022-08-08 16:07:26,091 - root - INFO - Setting up initial state
2022-08-08 16:07:26,095 - root - INFO - Setting up initial state
2022-08-08 16:07:26,099 - root - INFO - Setting up initial state
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2022-08-08 16:07:26,107 - root - INFO - Setting up initial state
2022-08-08 16:07:26,110 - root - INFO - Setting up initial state
2022-08-08 16:07:26,114 - root - INFO - Setting up initial state
2022-08-08 16:07:26,117 - root - INFO - Setting up initial state
2022-08-08 16:07:26,120 - root - INFO - Setting up initial state
2022-08-08 16:07:26,123 - root - INFO - Setting up initial state
2022-08-08 16:07:26,127 - root - INFO - Setting up initial state
2022-08-08 16:07:26,130 - root - INFO - Setting up initial state
2022-08-08 16:07:26,134 - root - INFO - Setting up initial state
2022-08-08 16:07:26,137 - root - INFO - Setting up initial state
2022-08-08 16:07:26,140 - root - INFO - Setting up initial state
2022-08-08 16:07:26,143 - root - INFO - Setting up initial state
2022-08-08 16:07:26,150 - root - INFO - Setting up initial state
2022-08-08 16:07:26,155 - root - INFO - Setting up initial state
2022-08-08 16:07:26,165 - root - INFO - Setting up initial state
2022-08-08 16:07:26,170 - root - INFO - Setting up initial state
2022-08-08 16:07:26,174 - root - INFO - Setting up initial state
2022-08-08 16:07:26,179 - root - INFO - Setting up initial state
2022-08-08 16:07:26,258 - root - INFO - Starting simulation 0 / run 2 / subset 0
2022-08-08 16:07:26,290 - root - INFO - Starting simulation 0 / run 4 / subset 0
2022-08-08 16:07:26,227 - root - INFO - Starting simulation 0 / run 0 / subset 0
2022-08-08 16:07:26,328 - root - INFO - Starting simulation 0 / run 6 / subset 0
```

```
2022-08-08 16:07:26,406 - root - INFO - Starting simulation 0 / run 8 / subset 0
2022-08-08 16:07:26,455 - root - INFO - Starting simulation 0 / run 10 / subset
0
2022-08-08 16:07:26,518 - root - INFO - Starting simulation 0 / run 12 / subset
0
2022-08-08 16:07:26,574 - root - INFO - Starting simulation 0 / run 14 / subset
0
2022-08-08 16:07:26,642 - root - INFO - Starting simulation 0 / run 16 / subset
0
2022-08-08 16:07:26,694 - root - INFO - Starting simulation 0 / run 18 / subset
0
2022-08-08 16:07:26,757 - root - INFO - Starting simulation 0 / run 20 / subset
0
2022-08-08 16:07:26,819 - root - INFO - Starting simulation 0 / run 22 / subset
0
2022-08-08 16:07:26,878 - root - INFO - Starting simulation 0 / run 24 / subset
0
2022-08-08 16:07:26,946 - root - INFO - Starting simulation 0 / run 26 / subset
0
2022-08-08 16:07:27,011 - root - INFO - Starting simulation 0 / run 28 / subset
0
2022-08-08 16:07:29,750 - root - INFO - Starting simulation 0 / run 2 / subset 1
2022-08-08 16:07:30,656 - root - INFO - Starting simulation 0 / run 6 / subset 1
2022-08-08 16:07:31,059 - root - INFO - Starting simulation 0 / run 20 / subset
1
2022-08-08 16:07:31,126 - root - INFO - Starting simulation 0 / run 4 / subset 1
2022-08-08 16:07:31,192 - root - INFO - Starting simulation 0 / run 8 / subset 1
2022-08-08 16:07:31,261 - root - INFO - Starting simulation 0 / run 12 / subset
1
2022-08-08 16:07:31,398 - root - INFO - Starting simulation 0 / run 14 / subset
1
2022-08-08 16:07:31,625 - root - INFO - Starting simulation 0 / run 24 / subset
1
2022-08-08 16:07:31,636 - root - INFO - Starting simulation 0 / run 18 / subset
1
2022-08-08 16:07:31,617 - root - INFO - Starting simulation 0 / run 10 / subset
1
2022-08-08 16:07:31,763 - root - INFO - Starting simulation 0 / run 16 / subset
1
2022-08-08 16:07:31,825 - root - INFO - Starting simulation 0 / run 28 / subset
1
2022-08-08 16:07:31,826 - root - INFO - Starting simulation 0 / run 22 / subset
1
2022-08-08 16:07:31,956 - root - INFO - Starting simulation 0 / run 0 / subset 1
2022-08-08 16:07:32,683 - root - INFO - Starting simulation 0 / run 26 / subset
1
2022-08-08 16:07:34,396 - root - INFO - Starting simulation 0 / run 13 / subset
0
```

```
2022-08-08 16:07:34,459 - root - INFO - Starting simulation 0 / run 3 / subset 0
2022-08-08 16:07:34,468 - root - INFO - Starting simulation 0 / run 9 / subset 0
2022-08-08 16:07:35,612 - root - INFO - Starting simulation 0 / run 19 / subset
0
2022-08-08 16:07:35,662 - root - INFO - Starting simulation 0 / run 21 / subset
0
2022-08-08 16:07:35,773 - root - INFO - Starting simulation 0 / run 7 / subset 0
2022-08-08 16:07:35,919 - root - INFO - Starting simulation 0 / run 29 / subset
0
2022-08-08 16:07:35,964 - root - INFO - Starting simulation 0 / run 17 / subset
0
2022-08-08 16:07:36,251 - root - INFO - Starting simulation 0 / run 15 / subset
0
2022-08-08 16:07:36,282 - root - INFO - Starting simulation 0 / run 25 / subset
0
2022-08-08 16:07:36,456 - root - INFO - Starting simulation 0 / run 23 / subset
0
2022-08-08 16:07:36,521 - root - INFO - Starting simulation 0 / run 11 / subset
0
2022-08-08 16:07:36,593 - root - INFO - Starting simulation 0 / run 5 / subset 0
2022-08-08 16:07:36,966 - root - INFO - Starting simulation 0 / run 1 / subset 0
2022-08-08 16:07:37,107 - root - INFO - Starting simulation 0 / run 27 / subset
0
2022-08-08 16:07:38,410 - root - INFO - Starting simulation 0 / run 13 / subset
1
2022-08-08 16:07:38,558 - root - INFO - Starting simulation 0 / run 3 / subset 1
2022-08-08 16:07:39,078 - root - INFO - Starting simulation 0 / run 9 / subset 1
2022-08-08 16:07:39,868 - root - INFO - Starting simulation 0 / run 15 / subset
1
2022-08-08 16:07:39,865 - root - INFO - Starting simulation 0 / run 21 / subset
1
2022-08-08 16:07:39,973 - root - INFO - Starting simulation 0 / run 19 / subset
1
2022-08-08 16:07:40,300 - root - INFO - Starting simulation 0 / run 23 / subset
1
2022-08-08 16:07:40,382 - root - INFO - Starting simulation 0 / run 17 / subset
1
2022-08-08 16:07:40,693 - root - INFO - Starting simulation 0 / run 5 / subset 1
2022-08-08 16:07:40,718 - root - INFO - Starting simulation 0 / run 7 / subset 1
2022-08-08 16:07:40,945 - root - INFO - Starting simulation 0 / run 11 / subset
1
2022-08-08 16:07:41,032 - root - INFO - Starting simulation 0 / run 29 / subset
1
2022-08-08 16:07:41,344 - root - INFO - Starting simulation 0 / run 25 / subset
1
2022-08-08 16:07:41,629 - root - INFO - Starting simulation 0 / run 27 / subset
1
2022-08-08 16:07:41,648 - root - INFO - Starting simulation 0 / run 1 / subset 1
```

```
2022-08-08 16:07:47,029 - root - INFO - Starting simulation 0 / run 30 / subset
0
2022-08-08 16:07:47,532 - root - INFO - Starting simulation 0 / run 32 / subset
0
2022-08-08 16:07:47,818 - root - INFO - Starting simulation 0 / run 34 / subset
0
2022-08-08 16:07:47,979 - root - INFO - Starting simulation 0 / run 36 / subset
0
2022-08-08 16:07:48,260 - root - INFO - Starting simulation 0 / run 38 / subset
0
2022-08-08 16:07:48,488 - root - INFO - Starting simulation 0 / run 40 / subset
0
2022-08-08 16:07:48,726 - root - INFO - Starting simulation 0 / run 42 / subset
0
2022-08-08 16:07:48,896 - root - INFO - Starting simulation 0 / run 44 / subset
0
2022-08-08 16:07:49,250 - root - INFO - Starting simulation 0 / run 46 / subset
0
2022-08-08 16:07:49,393 - root - INFO - Starting simulation 0 / run 48 / subset
0
2022-08-08 16:07:49,532 - root - INFO - Starting simulation 0 / run 50 / subset
0
2022-08-08 16:07:49,671 - root - INFO - Starting simulation 0 / run 52 / subset
0
2022-08-08 16:07:49,909 - root - INFO - Starting simulation 0 / run 30 / subset
1
2022-08-08 16:07:50,040 - root - INFO - Starting simulation 0 / run 54 / subset
0
2022-08-08 16:07:50,082 - root - INFO - Starting simulation 0 / run 32 / subset
1
2022-08-08 16:07:50,214 - root - INFO - Starting simulation 0 / run 56 / subset
0
2022-08-08 16:07:50,385 - root - INFO - Starting simulation 0 / run 58 / subset
0
2022-08-08 16:07:50,597 - root - INFO - Starting simulation 0 / run 34 / subset
1
2022-08-08 16:07:50,749 - root - INFO - Starting simulation 0 / run 36 / subset
1
2022-08-08 16:07:50,942 - root - INFO - Starting simulation 0 / run 38 / subset
1
2022-08-08 16:07:51,142 - root - INFO - Starting simulation 0 / run 40 / subset
1
2022-08-08 16:07:51,314 - root - INFO - Starting simulation 0 / run 42 / subset
1
2022-08-08 16:07:51,373 - root - INFO - Starting simulation 0 / run 44 / subset
1
2022-08-08 16:07:51,905 - root - INFO - Starting simulation 0 / run 46 / subset
1
```

```
2022-08-08 16:07:52,037 - root - INFO - Starting simulation 0 / run 48 / subset
1
2022-08-08 16:07:52,157 - root - INFO - Starting simulation 0 / run 50 / subset
1
2022-08-08 16:07:52,270 - root - INFO - Starting simulation 0 / run 52 / subset
1
2022-08-08 16:07:52,553 - root - INFO - Starting simulation 0 / run 31 / subset
0
2022-08-08 16:07:52,697 - root - INFO - Starting simulation 0 / run 54 / subset
1
2022-08-08 16:07:52,760 - root - INFO - Starting simulation 0 / run 33 / subset
0
2022-08-08 16:07:52,997 - root - INFO - Starting simulation 0 / run 56 / subset
1
2022-08-08 16:07:53,033 - root - INFO - Starting simulation 0 / run 58 / subset
1
2022-08-08 16:07:53,242 - root - INFO - Starting simulation 0 / run 35 / subset
0
2022-08-08 16:07:53,625 - root - INFO - Starting simulation 0 / run 39 / subset
0
2022-08-08 16:07:53,686 - root - INFO - Starting simulation 0 / run 41 / subset
0
2022-08-08 16:07:53,905 - root - INFO - Starting simulation 0 / run 43 / subset
0
2022-08-08 16:07:54,294 - root - INFO - Starting simulation 0 / run 45 / subset
0
2022-08-08 16:07:54,558 - root - INFO - Starting simulation 0 / run 47 / subset
0
2022-08-08 16:07:54,705 - root - INFO - Starting simulation 0 / run 49 / subset
0
2022-08-08 16:07:54,742 - root - INFO - Starting simulation 0 / run 37 / subset
0
2022-08-08 16:07:54,841 - root - INFO - Starting simulation 0 / run 51 / subset
0
2022-08-08 16:07:55,009 - root - INFO - Starting simulation 0 / run 53 / subset
0
2022-08-08 16:07:55,224 - root - INFO - Starting simulation 0 / run 31 / subset
1
2022-08-08 16:07:55,351 - root - INFO - Starting simulation 0 / run 55 / subset
0
2022-08-08 16:07:55,454 - root - INFO - Starting simulation 0 / run 33 / subset
1
2022-08-08 16:07:55,670 - root - INFO - Starting simulation 0 / run 57 / subset
0
2022-08-08 16:07:55,742 - root - INFO - Starting simulation 0 / run 59 / subset
0
2022-08-08 16:07:55,933 - root - INFO - Starting simulation 0 / run 35 / subset
1
```

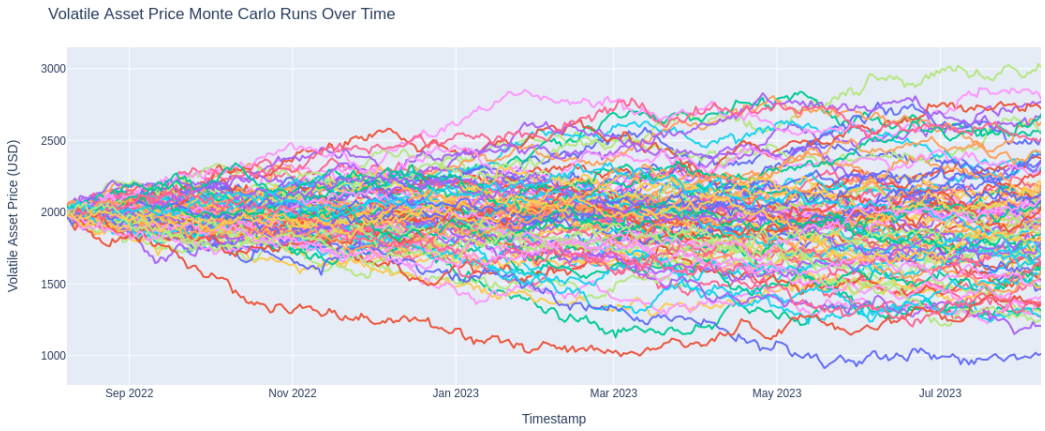
```
2022-08-08 16:07:56,257 - root - INFO - Starting simulation 0 / run 41 / subset
1
2022-08-08 16:07:56,306 - root - INFO - Starting simulation 0 / run 39 / subset
1
2022-08-08 16:07:56,439 - root - INFO - Starting simulation 0 / run 43 / subset
1
2022-08-08 16:07:57,112 - root - INFO - Starting simulation 0 / run 45 / subset
1
2022-08-08 16:07:57,164 - root - INFO - Starting simulation 0 / run 47 / subset
1
2022-08-08 16:07:57,220 - root - INFO - Starting simulation 0 / run 49 / subset
1
2022-08-08 16:07:57,453 - root - INFO - Starting simulation 0 / run 51 / subset
1
2022-08-08 16:07:57,617 - root - INFO - Starting simulation 0 / run 53 / subset
1
2022-08-08 16:07:57,739 - root - INFO - Starting simulation 0 / run 37 / subset
1
2022-08-08 16:07:57,893 - root - INFO - Starting simulation 0 / run 55 / subset
1
2022-08-08 16:07:58,359 - root - INFO - Starting simulation 0 / run 59 / subset
1
2022-08-08 16:07:58,518 - root - INFO - Starting simulation 0 / run 57 / subset
1
2022-08-08 16:08:01,520 - root - INFO - Starting simulation 0 / run 60 / subset
0
2022-08-08 16:08:01,747 - root - INFO - Starting simulation 0 / run 62 / subset
0
2022-08-08 16:08:02,172 - root - INFO - Starting simulation 0 / run 64 / subset
0
2022-08-08 16:08:02,706 - root - INFO - Starting simulation 0 / run 66 / subset
0
2022-08-08 16:08:02,828 - root - INFO - Starting simulation 0 / run 68 / subset
0
2022-08-08 16:08:03,049 - root - INFO - Starting simulation 0 / run 70 / subset
0
2022-08-08 16:08:03,307 - root - INFO - Starting simulation 0 / run 72 / subset
0
2022-08-08 16:08:03,572 - root - INFO - Starting simulation 0 / run 74 / subset
0
2022-08-08 16:08:03,759 - root - INFO - Starting simulation 0 / run 76 / subset
0
2022-08-08 16:08:04,305 - root - INFO - Starting simulation 0 / run 78 / subset
0
2022-08-08 16:08:04,430 - root - INFO - Starting simulation 0 / run 80 / subset
0
2022-08-08 16:08:04,556 - root - INFO - Starting simulation 0 / run 60 / subset
1
```

```
2022-08-08 16:08:04,586 - root - INFO - Starting simulation 0 / run 62 / subset
1
2022-08-08 16:08:04,642 - root - INFO - Starting simulation 0 / run 82 / subset
0
2022-08-08 16:08:05,078 - root - INFO - Starting simulation 0 / run 84 / subset
0
2022-08-08 16:08:05,252 - root - INFO - Starting simulation 0 / run 64 / subset
1
2022-08-08 16:08:05,317 - root - INFO - Starting simulation 0 / run 86 / subset
0
2022-08-08 16:08:05,416 - root - INFO - Starting simulation 0 / run 66 / subset
1
2022-08-08 16:08:05,537 - root - INFO - Starting simulation 0 / run 88 / subset
0
2022-08-08 16:08:05,670 - root - INFO - Starting simulation 0 / run 68 / subset
1
2022-08-08 16:08:05,774 - root - INFO - Starting simulation 0 / run 70 / subset
1
2022-08-08 16:08:06,192 - root - INFO - Starting simulation 0 / run 74 / subset
1
2022-08-08 16:08:06,372 - root - INFO - Starting simulation 0 / run 72 / subset
1
2022-08-08 16:08:06,574 - root - INFO - Starting simulation 0 / run 76 / subset
1
2022-08-08 16:08:06,913 - root - INFO - Starting simulation 0 / run 78 / subset
1
2022-08-08 16:08:07,149 - root - INFO - Starting simulation 0 / run 63 / subset
0
2022-08-08 16:08:07,200 - root - INFO - Starting simulation 0 / run 80 / subset
1
2022-08-08 16:08:07,214 - root - INFO - Starting simulation 0 / run 61 / subset
0
2022-08-08 16:08:07,286 - root - INFO - Starting simulation 0 / run 82 / subset
1
2022-08-08 16:08:07,664 - root - INFO - Starting simulation 0 / run 84 / subset
1
2022-08-08 16:08:07,850 - root - INFO - Starting simulation 0 / run 65 / subset
0
2022-08-08 16:08:07,956 - root - INFO - Starting simulation 0 / run 86 / subset
1
2022-08-08 16:08:07,971 - root - INFO - Starting simulation 0 / run 67 / subset
0
2022-08-08 16:08:08,322 - root - INFO - Starting simulation 0 / run 88 / subset
1
2022-08-08 16:08:08,333 - root - INFO - Starting simulation 0 / run 71 / subset
0
2022-08-08 16:08:08,814 - root - INFO - Starting simulation 0 / run 75 / subset
0
```

```
2022-08-08 16:08:09,063 - root - INFO - Starting simulation 0 / run 73 / subset
0
2022-08-08 16:08:09,105 - root - INFO - Starting simulation 0 / run 77 / subset
0
2022-08-08 16:08:09,239 - root - INFO - Starting simulation 0 / run 69 / subset
0
2022-08-08 16:08:09,461 - root - INFO - Starting simulation 0 / run 79 / subset
0
2022-08-08 16:08:09,739 - root - INFO - Starting simulation 0 / run 63 / subset
1
2022-08-08 16:08:09,790 - root - INFO - Starting simulation 0 / run 61 / subset
1
2022-08-08 16:08:09,838 - root - INFO - Starting simulation 0 / run 83 / subset
0
2022-08-08 16:08:09,894 - root - INFO - Starting simulation 0 / run 81 / subset
0
2022-08-08 16:08:10,214 - root - INFO - Starting simulation 0 / run 85 / subset
0
2022-08-08 16:08:10,432 - root - INFO - Starting simulation 0 / run 65 / subset
1
2022-08-08 16:08:10,498 - root - INFO - Starting simulation 0 / run 87 / subset
0
2022-08-08 16:08:10,562 - root - INFO - Starting simulation 0 / run 67 / subset
1
2022-08-08 16:08:10,905 - root - INFO - Starting simulation 0 / run 89 / subset
0
2022-08-08 16:08:10,940 - root - INFO - Starting simulation 0 / run 71 / subset
1
2022-08-08 16:08:11,340 - root - INFO - Starting simulation 0 / run 75 / subset
1
2022-08-08 16:08:11,648 - root - INFO - Starting simulation 0 / run 73 / subset
1
2022-08-08 16:08:11,724 - root - INFO - Starting simulation 0 / run 77 / subset
1
2022-08-08 16:08:12,110 - root - INFO - Starting simulation 0 / run 79 / subset
1
2022-08-08 16:08:12,131 - root - INFO - Starting simulation 0 / run 69 / subset
1
2022-08-08 16:08:12,397 - root - INFO - Starting simulation 0 / run 83 / subset
1
2022-08-08 16:08:12,705 - root - INFO - Starting simulation 0 / run 81 / subset
1
2022-08-08 16:08:12,943 - root - INFO - Starting simulation 0 / run 85 / subset
1
2022-08-08 16:08:13,047 - root - INFO - Starting simulation 0 / run 87 / subset
1
2022-08-08 16:08:13,568 - root - INFO - Starting simulation 0 / run 89 / subset
1
```

```
2022-08-08 16:08:16,035 - root - INFO - Starting simulation 0 / run 90 / subset
0
2022-08-08 16:08:16,228 - root - INFO - Starting simulation 0 / run 92 / subset
0
2022-08-08 16:08:16,699 - root - INFO - Starting simulation 0 / run 94 / subset
0
2022-08-08 16:08:17,349 - root - INFO - Starting simulation 0 / run 96 / subset
0
2022-08-08 16:08:17,544 - root - INFO - Starting simulation 0 / run 98 / subset
0
2022-08-08 16:08:18,879 - root - INFO - Starting simulation 0 / run 90 / subset
1
2022-08-08 16:08:18,973 - root - INFO - Starting simulation 0 / run 92 / subset
1
2022-08-08 16:08:19,258 - root - INFO - Starting simulation 0 / run 94 / subset
1
2022-08-08 16:08:19,801 - root - INFO - Starting simulation 0 / run 96 / subset
1
2022-08-08 16:08:19,940 - root - INFO - Starting simulation 0 / run 98 / subset
1
2022-08-08 16:08:20,766 - root - INFO - Starting simulation 0 / run 93 / subset
0
2022-08-08 16:08:20,774 - root - INFO - Starting simulation 0 / run 91 / subset
0
2022-08-08 16:08:21,048 - root - INFO - Starting simulation 0 / run 95 / subset
0
2022-08-08 16:08:21,442 - root - INFO - Starting simulation 0 / run 97 / subset
0
2022-08-08 16:08:21,581 - root - INFO - Starting simulation 0 / run 99 / subset
0
2022-08-08 16:08:22,397 - root - INFO - Starting simulation 0 / run 91 / subset
1
2022-08-08 16:08:22,487 - root - INFO - Starting simulation 0 / run 93 / subset
1
2022-08-08 16:08:22,757 - root - INFO - Starting simulation 0 / run 95 / subset
1
2022-08-08 16:08:23,101 - root - INFO - Starting simulation 0 / run 97 / subset
1
2022-08-08 16:08:23,228 - root - INFO - Starting simulation 0 / run 99 / subset
1
2022-08-08 16:08:27,228 - root - INFO - Experiment complete in 62.05948281288147
seconds
2022-08-08 16:08:27,229 - root - INFO - Post-processing results
2022-08-08 16:10:12,050 - root - INFO - Post-processing complete in
104.82124829292297 seconds
```

Volatile asset trajectories for each MC run:



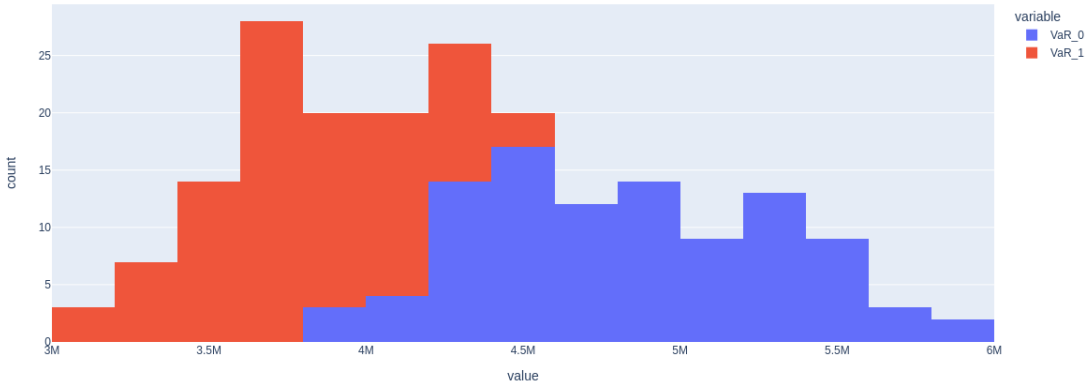
7.1 PCV at Risk Computation

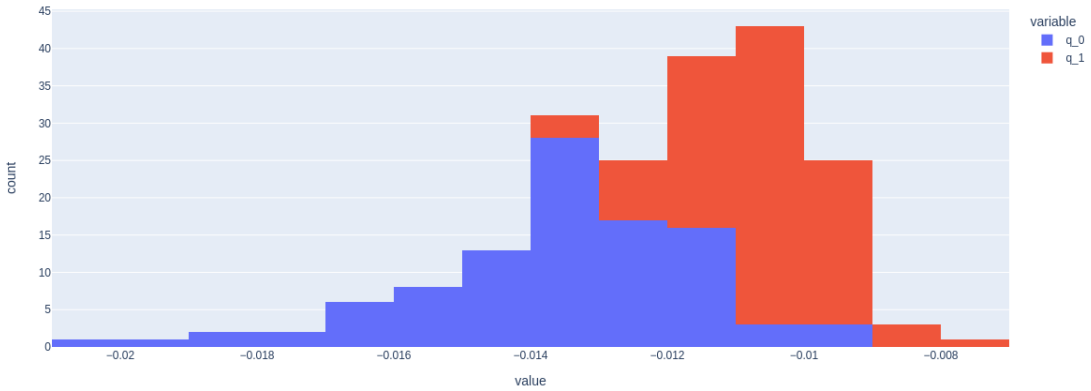
Here we compute the empirical distribution of the PCV at Risk (PCVaR) KPI which will inform how likely the PCV portfolio is to lose value over a certain time horizon. For definition see docs.

We set the confidence level (quantile level) at:

$$\alpha = 0.95$$

In the plots below we see the resulting empirical distribution of the VaR KPI for both policy settings.





As can be seen from the plots, VaR in absolute terms is higher with policy 1 than with policy 2, but the quantile level of PCV returns corresponding to $\alpha = 0.95$ is higher in policy 2 than in policy 1.

This is in accordance with intuition - a more conservative policy (higher stable backing) will result in less exposure to volatile asset price movements hence lower potential losses.

```
1-day average PCV at Risk at 95.0th quantile for subset 0:
 4,832,059.32 USD
1-day average PCV at Risk at 95.0th quantile for subset 0:
 3,819,235.04 USD
```

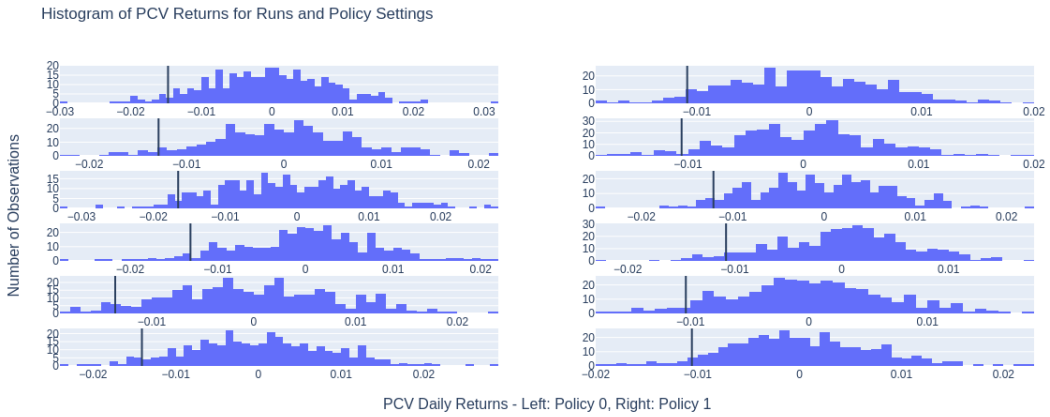
It is of interest to compute what the likelihood of PCV at risk being greater than a certain level of returns is, to evaluate the resiliency of the policy. Here, we choose a threshold of no more than 1% of total PCV at risk per day.

```
For Policy 1, the 1-Day PCV at Risk is less than 1.00% with a 3.00% probability
For Policy 2, the 1-Day PCV at Risk is less than 1.00% with a 26.00% probability
```

As we can see, since policy 2 is more conservative, it is more effective in having a statistically lower value of PCVaR, implying more contained losses for the protocol.

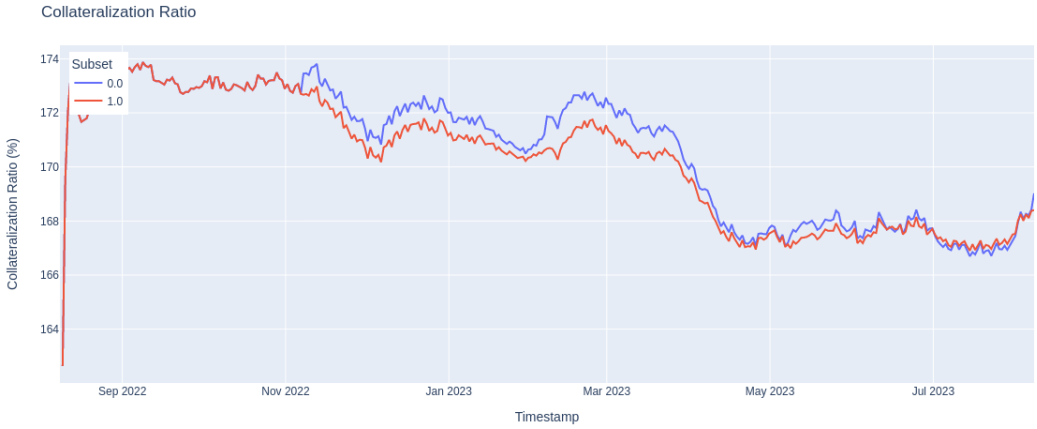
```
The Average PCVaR Delta between parameter for policies 1 and 2 is:
 1,012,824.28 USD
The Average PCVaR Quantile Delta between parameter for policies 1 and 2 is:
 -0.0029
```

If you wish to inspect specific realizations of the PCVaR KPI computed on the distributions of PCV returns across policies, the function below can be used with a certain number of runs.



7.2 Effect on Collateralization Ratio

In addition, let us look at the dowstream effect of the target stable backing ratio policy settings on the protocol's collateralization ratio.



In the plot above we see the average collateralization ratio evolution over 100 monte carlo runs for both policies.

```
The empirical probability of Collateralization Ratio being higher on average
with policy 1 than policy 2 is 50.0 %
The empirical probability of Collateralization Ratio Sharpe being higher with
policy 1 than policy 2 is 0.0 %
```

Here we compute the probability that, averaged over all monte carlo runs, the mean collateralization ratio is higher in one policy compared to another. We also compute a metric for risk-adjusted return, the sharpe ratio.

As can be seen, with the volatile exposure policy, collateralization ratio is on average higher than with the conservative policy, however its sharpe ratio is never higher (0% probability). This means that when taking risk into consideration, the conservative policy is more effective virtually all the time.

7.2.1 Conclusion

In this analysis we see how the PCVaR KPI can be leveraged in gauging the statistical soundness of PCV Management for different KPI targets.

Here we expressly chose to compare a very volatile-exposed policy to a highly conservative one, in line with FEI's recent FIPs, to illustrate clear-cut results which under multiple facets all point to the recommendation of the conservative policy.